



**BARCELONA DUST FORECAST CENTER
(WMO Regional Specialized Meteorological Center with activity
specialization on Atmospheric Sand and Dust Forecast)**

Activity Report 2015

Enric Terradellas (AEMET) and Sara Basart (BSC-CNS)

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Barcelona Dust Forecast Center

Barcelona Supercomputing Center

Nexus II Building

Jordi Girona, 29

08034 Barcelona (Spain)

Phone: (+34) 93 413 76 12

Fax: (+34) 93 413 77 21

Website: <http://dust.aemet.es>

E-mail: dust@aemet.es

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1. Introduction

The **Barcelona Dust Forecast Center** (BDFC, <http://dust.aemet.es>) was created in February 2014 by the **State Meteorological Agency** of Spain (AEMET) and the **Barcelona Supercomputing Center** (BSC) to fulfil the commitment acquired with World Meteorological Organization (WMO) to host the first Regional Specialized Meteorological Center with activity specialization on Atmospheric Sand and Dust Forecast (RSMC-ASDF). The Center operationally generates and distributes predictions for Northern Africa (north of equator), Middle East and Europe.

As described in its Activity Report 2014 (Terradellas et al., 2015a) available at <http://dust.aemet.es/about-us/report-2014>, the BDFC daily prepares regional forecast fields using the **NMMB/BSC-Dust** model (Pérez et al., 2011; Haustein et al., 2012) over a domain covering Northern Africa, Middle East and Europe (25°W-65°E, 0°-65°N). BDFC predictions include dust load, dust surface concentration, dust optical depth at 550 nm, dust surface extinction at 550 nm and 3-hour accumulated dry and wet deposition from the starting time (12 UTC) up to a lead time of 72 hours.

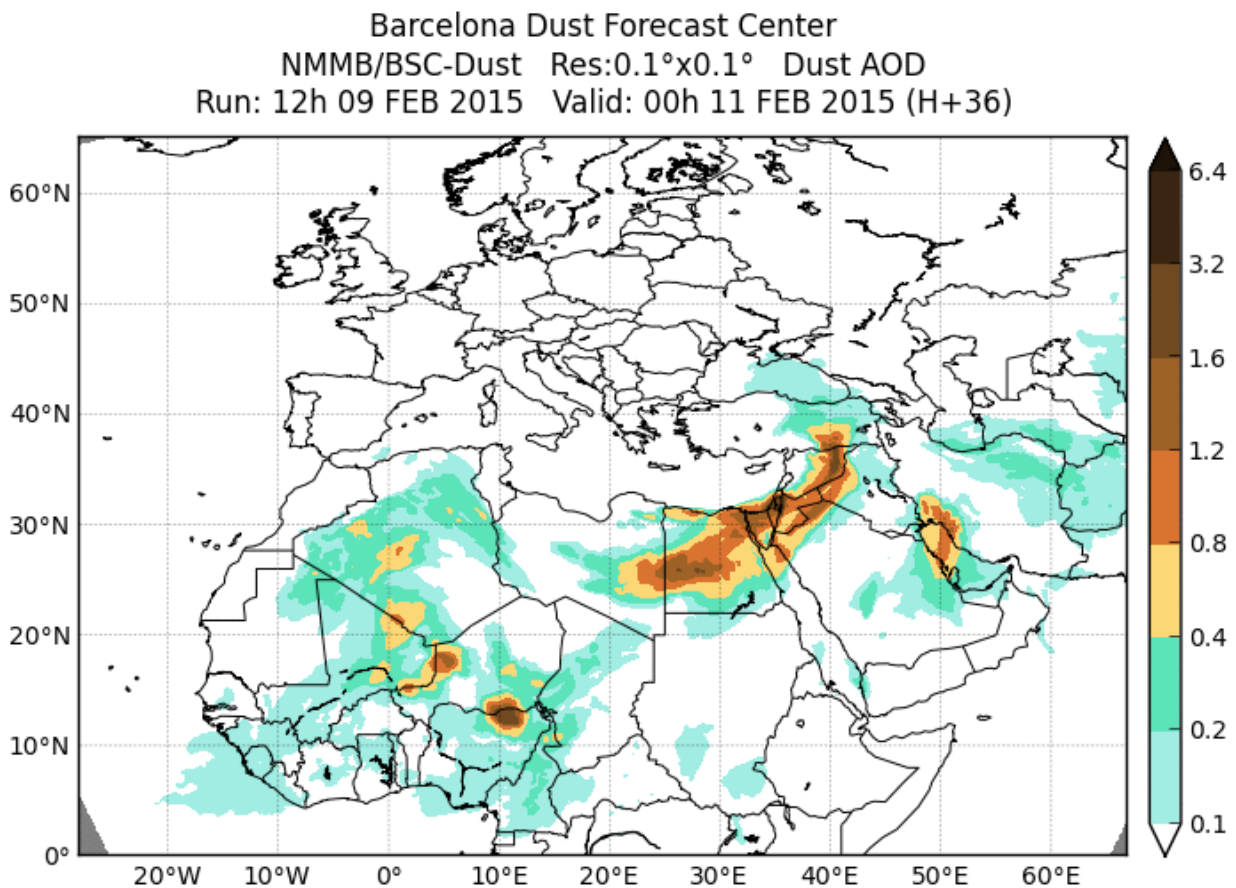


Figure 1. 36-hour forecast of dust optical depth valid for 11 Feb 2015 at 00 UTC

Monthly averages of dust surface concentration and dust load are computed for long-term monitoring.

2. Model integration

The NMMB/BSC-Dust model is daily integrated at a horizontal resolution of 0.1° longitude per 0.1° latitude with 40 σ -vertical levels on the IBM MareNostrum III supercomputer using dedicated resources. MareNostrum III is the core facility of the BSC.

A backup integration is daily performed at a horizontal resolution of 0.33° longitude per 0.33° latitude with 24 σ -vertical levels on a dedicated server.



Figure 2. Mare-Nostrum III supercomputer

Both model configurations use initial meteorological conditions from the U. S. **National Centers for Environmental Prediction** (NCEP) global analysis at a 0.5° latitude x 0.5° longitude horizontal resolution and 6-hourly boundary meteorological conditions from the NCEP Global Forecast System at the same resolution.

3. Forecast evaluation

The BDFC conducts regular evaluation of the predicted dust optical depth. In the Near-Real-Time (NRT) evaluation, forecasts of dust optical depth (DOD) are compared with total aerosol optical depth (AOD) provided by the **Aerosol Robotic Network** (AERONET, <http://aeronet.gsfc.nasa.gov/>; Holben et al.,

1998; Dubovik and King, 2000) for 40 selected dust-prone stations. Then, evaluation scores are computed on a monthly, seasonal and annual basis. To minimize the sources of error, it is intended to restrict the comparison to situations in which mineral dust is the dominant aerosol type. Threshold discrimination is made by discarding observations with an Ångström exponent 440-870 higher than 0.6. However, other particles are always present (anthropogenic aerosol, products from biomass burning, etc.) and therefore a negative bias can be expected.

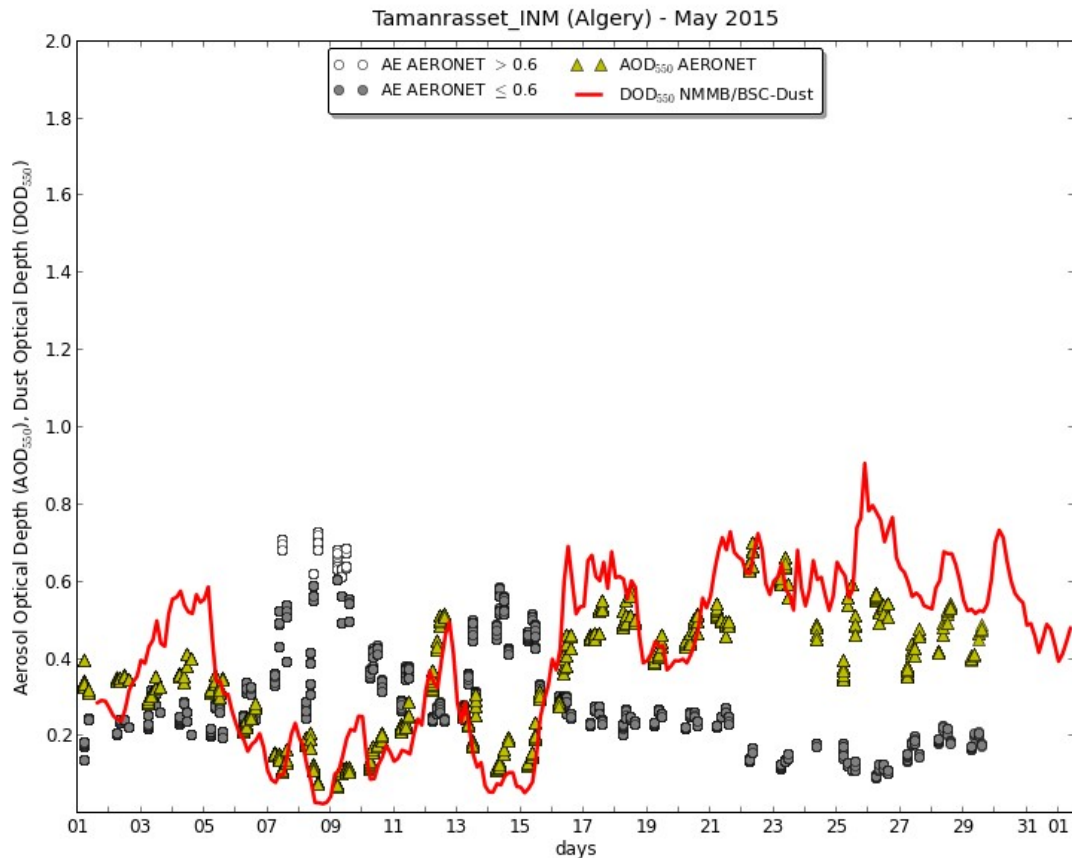


Figure 3. Evaluation of dust optical depth for March 2015 atTamanrasset, Algeria

The annual evaluation scores obtained for 2014 are summarized in Table 1

Area	Mean bias	r.m.s.e.	Correlation coefficient	Fractional Gross Error	Number of cases
Sahel / Sahara	-0.02	0.53	0.58	0.74	8143
Middle East	-0.25	0.56	0.18	0.73	1680
Mediterranean	-0.19	0.38	0.26	1.24	3908
TOTAL	-0.09	0.49	0.53	0.88	13731

Table 2. Annual evaluation scores for the forecasts released by the BDFC in 2015.

Evaluation of other parameters is waiting for the availability of suitable observational data sets. Some pilot tests conducted in the framework of the

WMO **Sand and Dust Storm Warning Advisory and Assessment System** (SDS-WAS) (I. e. Terradellas et al., 2015b) could be the starting point to develop and implement future routine evaluation systems.

4. Tailored products

A number of products has been adapted to the needs of specific users, in general for predicting dust at national level. In particular, the BDFC generates specific products for the NMHSs of Mauritania and Burkina Faso, for the **Scientific Research Council** of Spain and for the **African Centre of Meteorological Application for Development** (ACMAD).

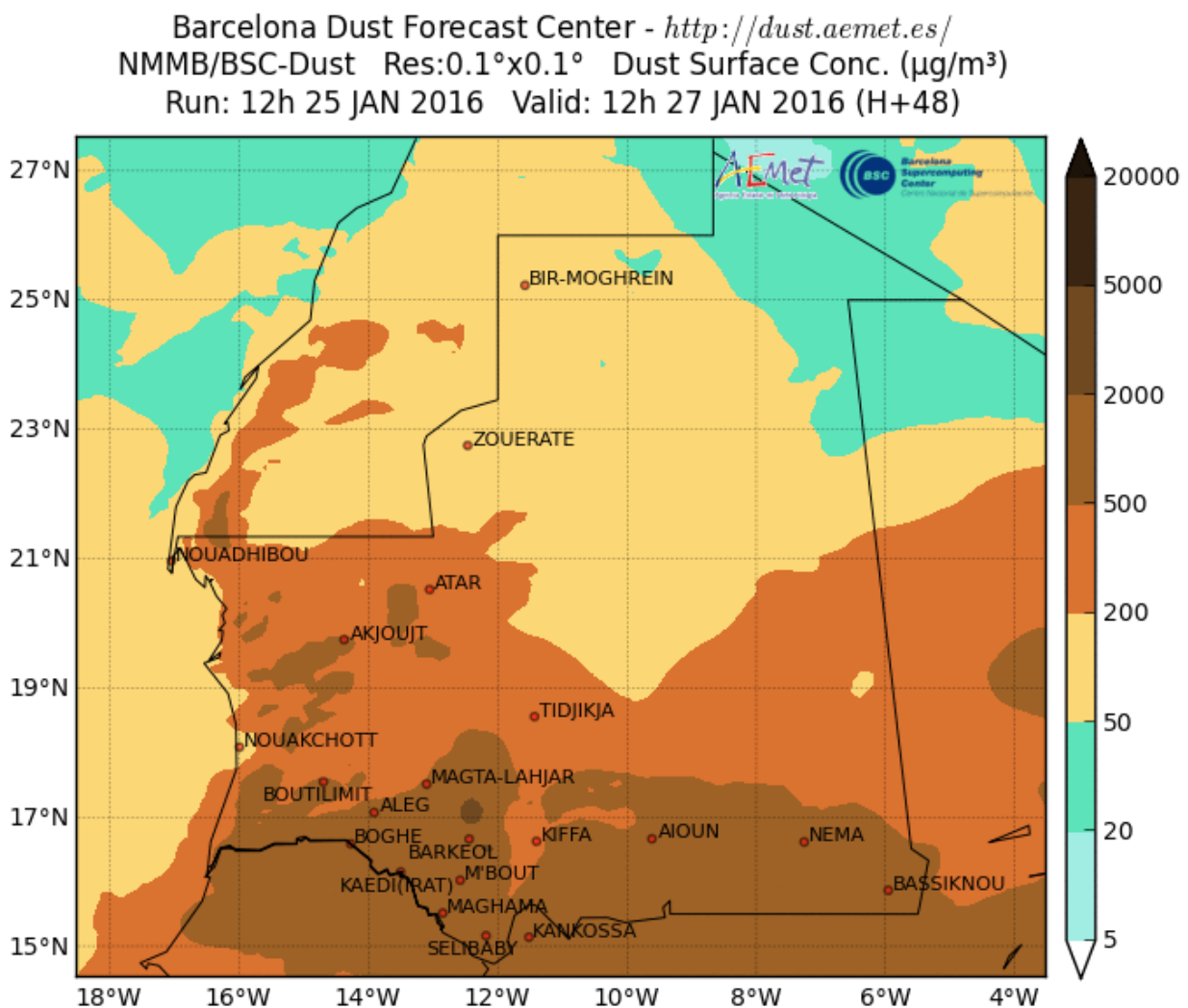


Figure 4. Product generated for the NMHS of Mauritania

5. Product dissemination

Operational forecasts are publicly available 12 hours after the starting forecast time through the Center's web portal (<http://dust.aemet.es>) and through the WMO Global Telecommunications System (GTS). The headers of the GTS bulletins are listed on the 2014 Activity Report and on the Center's web portal.

Following the efforts to make the predictions reach all potential users, in particular the National Meteorological and Hydrological Services (NMHSs), they are also transmitted through the **EUMETCast** service. Trial dissemination started on 15 October and operational service on 5 November 2015.

EUMETCast is a multi-service dissemination system based on standard Digital Video Broadcast (DVB) technology. It uses commercial telecommunication geostationary satellites to multi-cast files (data and products) to a wide user community. EUMETCast service is managed by EUMETSAT, the European agency for exploitation of meteorological satellites. It is the European contribution to **GEONETCast**.

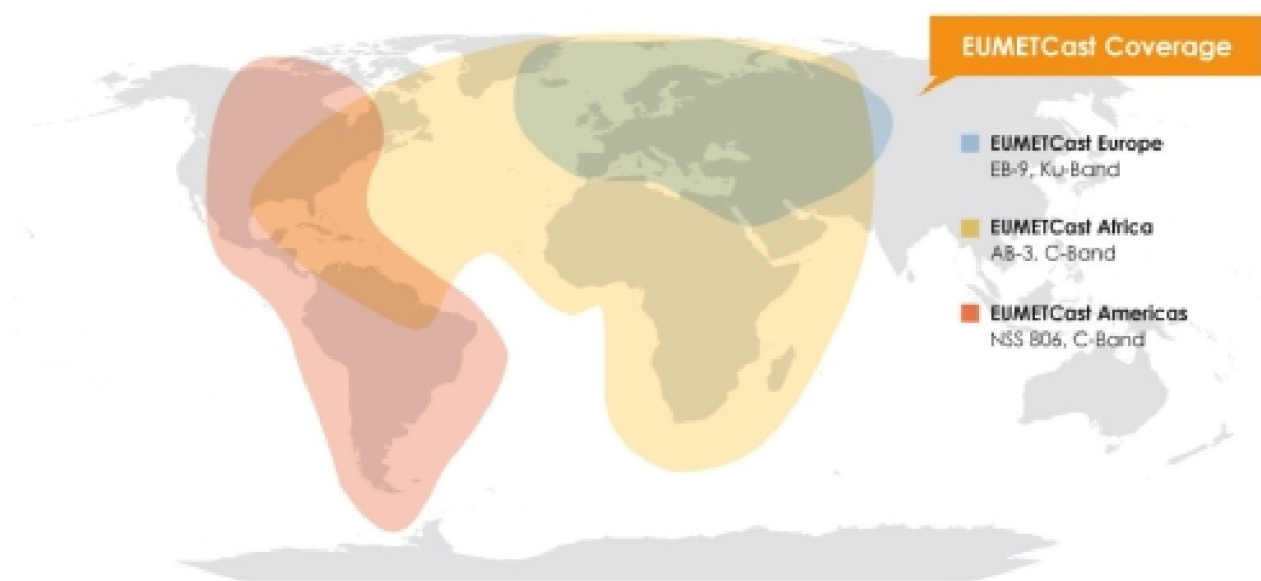


Figure 4. EUMETCast coverage

The products are distributed on EUMETCast Europe and Africa:

Channel: EUMETSAT Data Channel 12
Product ID: 301 (Europe and Africa)
Multicast Address: 224.223.222.35

6. Workshop on the Health Impact of Dust

The BDFC co-organized the **1st Africa / Middle East Expert Meeting and Workshop on the Health Impact of Airborne Dust**. The event, jointly financed by WMO, World Health Organization (WHO), United Nations Environment Programme (UNEP), EUMETSAT and AEMET was held in Amman, Jordan on 2-5 Novembre. The main objective was to assess the state of knowledge and encourage countries' actions with regard to impacts of airborne dust on public health in the region. The Expert Meeting and Workshop promoted active communication among dust-related service providers, African/Middle-Eastern NMHSs and relevant national and international

environment, air-quality and public health agencies.

59 participants from Algeria, Bahrain, Burkina Faso, Egypt, Iraq, Jordan, Kuwait, Lebanon, Mauritania, Morocco, Pakistan, Palestine, Poland, Saudi Arabia, Spain, Sweden, Tunisia, UAE, USA, Yemen, EUMETSAT, WMO, WHO and UNEP attended the workshop.



Figure 5. Opening session of the Expert Meeting and Workshop

The main conclusions can be summarized as follows:

Health:

- Plenty of evidence on health impact of particulate matter (including airborne dust) exists globally and can be utilized in the region in the absence of local evidence
- More resources (research and exchange of information) are needed to fill in the shortage of local evidence
- Efficiency of existing interventions to minimize exposure to airborne dust (masks, staying indoors, ...) is not fully known
- Lack of preparedness to respond to episodes of air pollution still persists in the region.

Meteorology:

- Global sand and dust monitoring, modelling and forecasting capacities exist. However, the present capabilities for capturing local and regional sand and dust episodes must be further improved
- National capacities for local monitoring, modelling and forecasting are still limited
- Data sharing at country and inter-country levels needs to be strengthened
- There is a lack of research in the area

Air quality:

- There are reasonable capabilities for air quality monitoring in some countries of the region. However, few initiatives on chemical and physical speciation and source apportionment do exist so far
- Reliability of data is an issue, as cross-calibration is generally not available
- Research activities are facing difficulties

7. Other events

7.1. Sand and Dust Storm: Forecast Services

Sand and Dust Storm: forecast Services was a side event held during the **17th Session of the World Meteorological Congress** held in Geneva, Switzerland, on 18 June.

The aim of the event was to present the BDFC to the Congress and to emphasize that the Center is the result of the transition from R & D activities to operational services. The agenda included the following talks:

- **Alexander Baklanov** (WMO): Transition from R&D to operational dust forecasts
- **Abdoulaye Harou** (WMO): Dust forecasts for health, air quality and aviation
- **Sara Basart** (BSC): Dust modelling
- **Enric Terradellas** (AEMET): Barcelona Dust Forecast Center: Operational services



Figure 6. Presentation of Dr. Sara Basart

7.2. The Edge of Crisis: Sand and Dust Storms

The Edge of Crisis: Sand and Dust Storms a side event of the 12th Session of the Conference of Parties of the **U. N. Convention to Combat Desertification**, held in Ankara, Turkey, on 15 November.

Deon Terblanche, Director of the WMO Atmospheric Research and Environment Department, presented the WMO **Sand and Dust Storm Warning Advisory and Assessment System**, which could become part of a wider United Nations system to better manage this phenomenon and its impacts. He stated that over the past 10 years, SDS-WAS fostered global research and cooperation on sand and dust storm related matters, in order to improve forecasts and warnings especially given the impacts on health, agriculture, transport and other sectors of the economy. He added that WMO's activities focus mainly on the understanding of sand and dust storm processes, its modelling and the prediction of such events to improve early warning services. **Enric Terradellas**, Technical Director of the BDFC, discussed about the transition from R&D to operational dust forecasts and presented the BDFC and its activities.

7.3. Scientific conferences

The methods used to generate the BDFC products have been presented at the European Geosciences Union General Assembly 2015 (Basart et al., 2015a) and the 3rd Iberian Meeting on Aerosol Science and Technology (Basart et al., 2015b).

8. Staff

Enric Terradellas, technical director
Sara Basart, research and operations
Francesco Benincasa and **Kim Serradell**, technical support
José M. Baldasano and **Emilio Cuevas**, scientific advisers

9. Users

The BDFC conducts regular monitoring of website access. The results (Table 2) show a steady increase in the number of users, sessions and page views.

Season	Users	Sessions	Page views
Mar - May 2014	422	878	2521
Jun - Aug 2014	1132	2449	6134
Sep - Nov 2014	1909	3175	6301
Dec 2014 - Feb 2015	1030	2352	5791
Mar - May 2015	4052	7202	15215
Jun - Aug 2015	5060	7455	13079
Sep - Nov 2015	10688	14569	28358

Table 2. Quarterly overview of the web access.

The top five countries ranked by number of visitors are Spain, United States, Iran, Saudi Arabia and France.

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